SUPPORTING INFORMATION

A TECHNO-ECONOMIC ANALYSIS OF CHEMICAL PROCESSING WITH IONIZING RADIATION

T. B. McConnaughy, M. R. Shaner, E. W. McFarland*

Correspondence: Dr. Eric W. McFarland (ewmcfar@engineering.ucsb.edu), University of Queensland, Dow Centre for Sustainable Engineering Innovation, School of Chemical Engineering, Queensland, Brisbane, QLD 4072, Australia.

DOI: 10.1002/ceat.201600507

Table S1: Typical G-values for UV and gamma/x-ray for a given reaction

REACTANT/PRODUCT	UV G (MICROMOLE/J)	GAMMA/X-RAY G (MICROMOLE/J)
CYCLOHEXANE,SO_2,CL_2 / CYCLOHEXANSULFONYL CHLORIDE	10^4 -10^5 (industry – lab)	8 x 10^4 (lab) [1]
O_2 / O_3	n/a	1
N_2,O_2 / NO_2	n/a	1
C_2H_4, HBR / C_2H_5BR	3.5 x 10^4 (@ 351nm) [2]	>10^4
C_2H_4, HCL / C_2H_5CL	n/a	10^3
CHLORINATION (EG. C_6H_6,CL_2 / C_6H_5CL)	6 x 10^3 (4eV) [3]	10^3 -10^4
CARBOHYDRATE OXIDATION	n/a	10^3 -10^4
SULFOCHLORINATION R,SO_2,CL_2 / SULFONIC ACID CHLORIDES	10^4 -10^5 (cite industry-lab) [4]	10^6

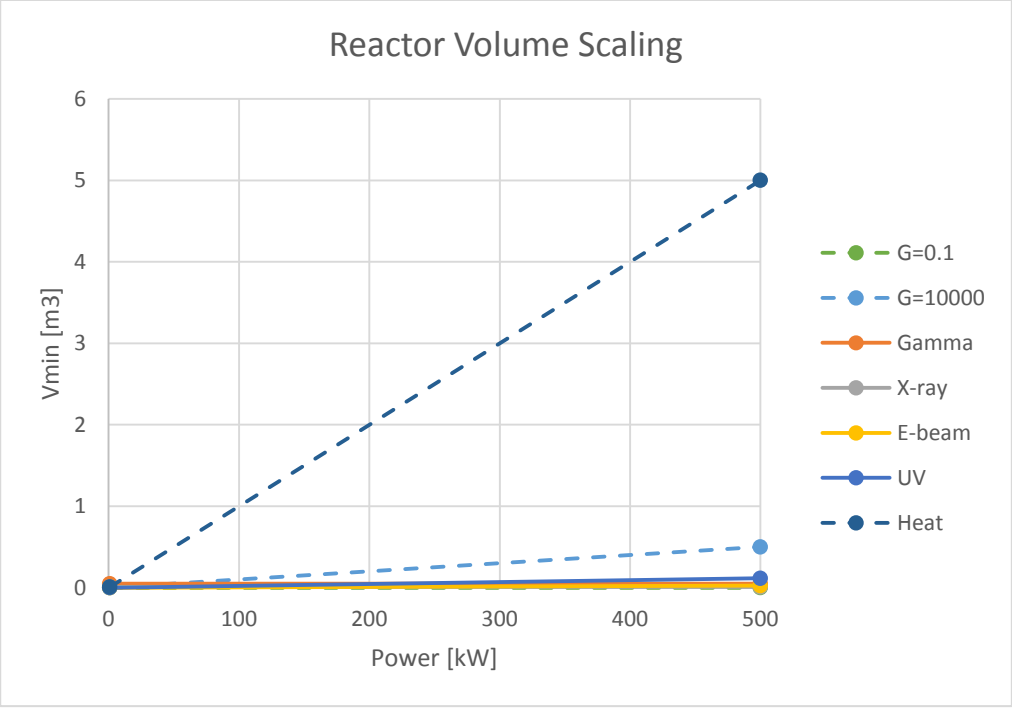

Figure S1: Reactor size scaling with power. Heat transfer determines the minimum reactor size throughout the practical power range.

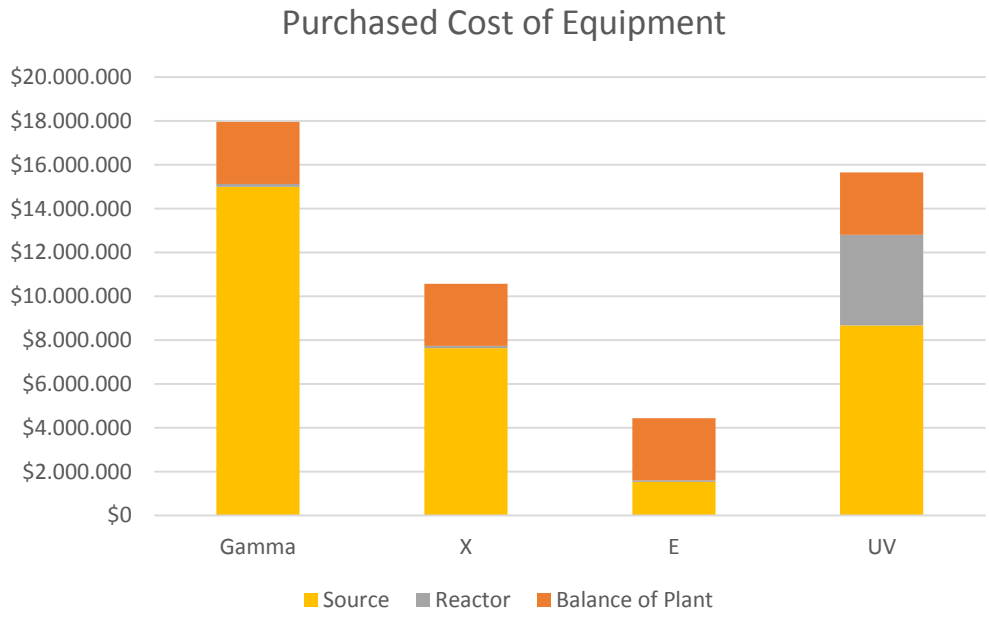

Figure S2: PCE for each system

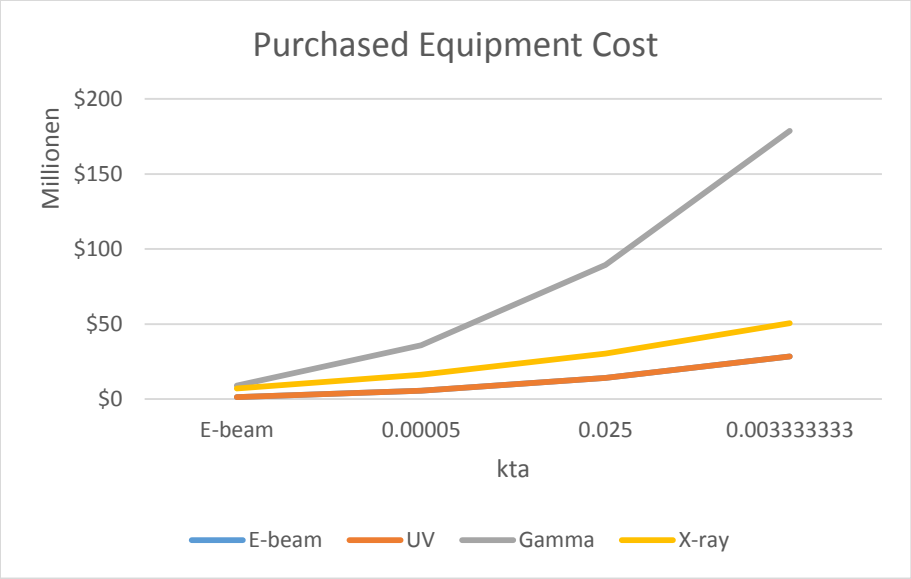

Figure S3: The effect of the purchased equipment cost on increasing production rate

REFERENCES

[1] A. Schneider and J. C. Chu, "Kinetics of sulfochlorination of cyclohexane in carbon tetrachloride induced by gamma radiation," *AIChE Journal,* vol. 10, pp. 930-934, 1964.

[2] J. Zavelovich and K. V. Reddy, "Photochemical process for the hydrobromination of olefinic double bonds," USA Patent US4643812 A, 1987.

[3] P. Klan and J. Wirz, *Photochemistry of Organic Compounds: From Concepts to Practice*: Wiley-Blackwell, 2009.

[4] J. P. Canselier, "Production of Alkanesulfonates and Related Compounds (High-Molecular-Weight Sulfonates)," in *Handbook of Detergents, Part F: Production*, U. Zoller and P. Sosis, Eds., ed: CRC Press, 2008.